

REMARKS

Claim 9 is canceled without prejudice to reentry, and its subject matter is added to independent claim 1. The features added to the third paragraph of claim 1 are inherent, and are also supported in the specification and drawing (e.g., the arrows in claim 1). The remaining features are supported in Fig. 1, showing the evaporator 36 in the duct 41 adjacent to the inlet and the radiator 32 adjacent to the outlet.

Claims 1, 3-5, and 7-8 are pending. In response to the outstanding Office Action:

(2-3) Claims 1-4 and 7-9 were rejected under 35 U.S.C. §103(a) as being obvious over Lanciaux, US 4,621,438, in view of Sakakibara, US 6,494,051. This rejection is respectfully traversed.

1. Concerning the present Application

Claim 1 describes a configuration,

....

a circulation duct *having an air inlet and an air outlet at respective ends thereof* for circulating drying air *therethrough in a direction from the air inlet to the air outlet*;

a radiator, disposed inside said circulation duct and *adjacent to the air outlet*, for condensing the refrigerant to heat the drying air;

an evaporator, disposed inside said circulation duct and *adjacent to the air inlet*, for evaporating the refrigerant to absorb heat from the drying air;

a first throttle apparatus and a second throttle apparatus for controlling the refrigerant pressure;

a heat exchanger, disposed inside said circulation duct and connected between said first throttle apparatus and said second throttle apparatus, functioning as another radiator for condensing the refrigerant to heat the drying air or as another evaporator for evaporating the

refrigerant to absorb heat from the drying air, depending on the refrigerant pressure controlled by said first throttle apparatus and said second throttle apparatus;

....

a refrigerant pipe connecting, in the following order, said compressor; said radiator; said first throttle apparatus; said heat exchanger; said second throttle apparatus; and said evaporator, in a series circuit of the refrigerant.

Because of the claimed configuration, it is possible to switch the heat exchanger between the evaporator and the radiator, by controlling the channel resistance of the throttle apparatus provided on the inlet side and outlet side of the heat exchanger.

Therefore, the heating surface area able to be utilized for radiating the refrigerant's heat to the drying air is *increased*, and the heating surface area to be utilized for absorbing heat from the drying air is *reduced*, when the discharge pressure of the compressor exceeds the predetermined value ("depending on the refrigerant pressure"), without relying on the condition of the outside air. Thus, according to the Applicants, it is possible to bring the high pressure side refrigerant temperature close to the drying air temperature so as to reduce the high pressure side refrigerant pressure, suppress the reduction in the enthalpy difference of refrigerant in the radiator, and improve the COP of the heat pump cycle.^{1/}

In the claimed the heat pump of the Applicants, the evaporator is always disposed on the side of the inlet of the air circulation duct and the radiator is always

^{1/} The Examiner is referred to the Applicants' Fig. 11, a Mollier diagram that, according to the specification, illustrates the "principle that the COP (coefficient of performance) of the heat pump when the heat pump is operated under the high temperature atmosphere is deteriorated will be explained. As described above, if the atmosphere temperature rises, the average temperature of air in the circulation duct rises, and a pressure of refrigerant sucked by the compressor rises. With this, the density of refrigerant sucked by the compressor is increased, and a circulation amount of the refrigerant in the heat pump cycle is increased. Thus, the heat pump cycle is shifted as shown in FIG. 11, an enthalpy difference of the refrigerant in the radiator is reduced, and the COP of the heat pump cycle is deteriorated."

disposed on the side of the outlet of the duct, and the function of the heat exchanger sandwiched between the evaporator and the radiator are switched. Therefore the configuration, in which damp air sucked into the duct from the drying room is dehumidified by the evaporator and then the air is heated by the radiator and sent to the drying room, is maintained.

2. Comparison with references

In Lanciaux, the condenser 150 is asserted to be physically divided into two portions, .i.e., into the asserted 3rd heat exchanger and the rest of the condenser 150. The rejection urges that expansion valves would have been provided at the inlet and outlet of the 3rd heat exchanger, and further, that the 3rd heat exchanger would be made to function as the condenser or the evaporator.

(1) The Examiner is referred to the attachment, where the two throttles of Sakakibara are hypothetically provided at the inlet (second throttle valve) and the outlet (first throttle valve) of the asserted 3rd heat exchanger.

In order to make the 3rd heat exchanger function as the evaporator, it is necessary to increase the flow resistance at the second throttle valve, and to add "expansion steps $2 \Rightarrow 3$ " and "evaporating steps $3 \Rightarrow 4$ " after "compression steps $1 \Rightarrow 2$ " as shown in the Mollier diagram.

However, if the 3rd heat exchanger were to carry out the "evaporating steps $3 \Rightarrow 4$ ", the refrigerant temperature would be lowered with respect to the "compression steps $1 \Rightarrow 2$." Therefore, even if the refrigerant were made to flow to the condenser

150 in a state where the flow resistance of the first throttle valve is reduced, since the refrigerant temperature is low, it would not be possible to radiate heat to surrounding air. That is, since the condenser 150 then could not function, the refrigeration cycle of Lanciaux would be inoperable.

In other words, if the asserted 3rd heat exchanger, that is sandwiched between the compressor 149 and the condenser 150, were to function as a condenser, no refrigeration could be performed. That would be contrary to the reference itself, and therefore would not have been done by the person of ordinary skill in the art.

On the other hand, if the 3rd heat exchanger were to function as an evaporator, it would be necessary to connect another compressor to the outlet of the 3rd heat exchanger so as to again compress the refrigerant to a high temperature, high pressure refrigerant gas (dot line on Mollier diagram of the attachment).

Thus, both cases are excluded. Moreover, the person of ordinary skilled in the art would not employ a configuration with two compressors.

(2) The Examiner asserts that the claimed feature, “a heat exchanger, disposed inside said circulation duct, for functioning as another radiator ... or as another evaporator ... depending on the refrigerant pressure controlled by said throttle apparatus” is anticipated. However, there is no evidence for the asserted third heat exchanger and the citation to Fig. 15 (bottom of page 4 of the Action) is, with respect, incorrect.

(3) The Examiner also asserts that the claimed dependence on the refrigerant pressure is anticipated because “the amount the heat exchanger assists other heat

exchangers is obviously dependent on the amount of refrigerant flowing through it," which we think does not actually support the rejection.

(4) The Examiner has not answered the Applicants' argument in the last response, namely,

In the final paragraph on page 2, the Examiner presents an annotated Fig. 15, as well as the annotated Fig. 16. From Lanciaux's description of the figures, Fig. 15 is a downward view of the dryer seen in Fig. 12, and Fig. 16 is a rear view of the same dryer. The heat exchangers 150 and 151 are labeled in Fig. 16, showing 150 on the right-hand side and 151 on the left-hand side; they are also labeled in Fig. 15, but with 151 on the right-hand side and 150 on the left-hand side due to the different viewpoint.

(5) Claims 3 and 4 are rejected over col. 6, lines 40-48 and col. 10, line 13-22, but the cited text has no mention of pressure detection or temperature detection, only flow detection used to stabilize the pressure or temperature.

4. Rejection of Claim 5

Claim 5 is rejected under 35 U.S.C. §103(a) as being obvious over Lanciaux in view of Sakakibara and further in view of Honda, US 2001/0018831. This rejection is respectfully traversed on the basis of the dependence of claim 5 and other bases.

In view of the aforementioned amendments and accompanying remarks, the application is submitted to be in condition for allowance, which action is requested.

Respectfully submitted,

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Lanciaux

In order to make the heat exchanger as the evaporator, it is necessary to add "expansion steps $2 \rightarrow 3$ " and "evaporating steps $3 \rightarrow 4$ " after "compression steps $1 \rightarrow 2$ ". However, in the "evaporating steps $3 \rightarrow 4$ ", although it is possible to lower the refrigerant temperature with respect to the "compression steps $1 \rightarrow 2$ ", and absorb heat from the surrounding air, it is not possible to radiate heat to the surrounding air. Even if refrigerant in the state of 4 flows into the condenser, it is not possible to radiate heat to the surrounding air.

Therefore, the refrigeration cycle can not be formed.

